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Determination of Synthetic Recovery Cost for Historical Towns in Deficit of Information Conditions: an Experimental Model

Francesco Calabrò[a], Tiziana Meduri[a], Carmen Tramontana[a,]*

[a]*PAU Dept. Mediterranea University of Reggio Calabria, Salita Melissari, 89124 Reggio Calabria, Italy*

Abstract

This paper is the result of an activity of still being tested research. It aims to provide a tool for the synthetic estimate of recovery costs for historic buildings in the phase of planning of measures, to be used in situations where it is not possible to have the necessary information for the application of more sophisticated instruments. The estimation method proposed arises from the need to program the recovery plans for old towns, especially those which are abandoned. This will take on a particular importance in view of their considerable potential new functions aimed at the sustainable development of territories as they fall, constituting an important part of the cultural landscape that characterizes the Inner Areas: areas in which identity resources, such as historical buildings, still remain and are a tool that can also give an economic perspective for these territories.

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1. Introduction

After long being underestimated, the role that Inner Areas have to ensure the balanced development of territories has finally been recognized, implicitly recognizing the anticipatory character of many studies on the subject by

* Corresponding author. Tel.: +39 349.4091348.
E-mail address: carmen.tramontana@unirc,it

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Edoardo Mollica (Mollica E.,1997). Infact, in 2014/2020 programming, Inner Areas, like the City and the South, are counted among the strategic priorities (Ministro per la Coesione Territoriale, et al., 2012), so as to have developed a specific National Strategy (Strategia nazionale per le Aree interne, 2012).
Without discussing here, organically, the policy in favor of such areas, one of the aspects of greatest interest is the enhancement of identity resources, as a tool that can also give an economic perspective in these Inner Areas. In such policies, the enhancement of historical towns, especially those now abandoned, is of particular importance due to their considerable potential, in spite of tampering suffered before their final abandonment (Calabrò, F., Campolo D., Cassalia G., Tramontana C., 2015). This paper aims to provide a tool for the synthetic estimate of historical building heritage recovery costs in the phase of intervention planning: the application field of this tool refers to situations where there is no required information for the application of more sophisticated tools.
The principal difficulty for Municipalities, when they want to program recovery and enhancement interventions for abandoned historical built heritage, is the recurrent impossibility to access inside the buildings, to be able to see the actual conditions of degradation and, therefore, to clearly define the type and the amount of interventions to be carried out (Antoniucci, V., & Marella, G. 2014). The developed procedure, called De.S.C. (Determination of Synthetic costs) currently in the testing phase, is based on some considerations arising from field observations:

- In the case of abandoned historical heritage buildings, for the purpose of its reuse, its interior must be essentially repaired: interventions as systems, finishes, sanitation are recurrent actions whatever be the building's structural condition.
- As long as the roof is in a good state of conservation, the floor's structures inside will hardly have structural problems;
- In case of roofs in good conservation status, structural problems can be caused only by foundation structures failure.

Based on these consideration and considering when it is not possible enter in buildings to verify better decay conditions, for the purposes of a synthetic estimate, the proposed method gathers the recovery interventions in three classes, related to the buildings' structural conditions, evaluated through an external inspection.
Through the use of sample buildings, representing the three degradation levels and where it is possible to enter inside, we can estimate estimated the parametric costs to apply then to all the buildings to be recovered.
With these premises, the tool proposed cannot be characterized by high reliability levels, such as during the programming phase of the building process however this may change the intended meaning. On the other hand, can support the decision maker to reduce the estimate's uncertainty to acceptable levels, during a phase of the building process such as the programming which is susceptible to suitable corrections in subsequent project phases.

2. The scientific base

Among the rapid estimation procedures of costs, based on a buildings' conservation status, is enumerated, first by the Rapid Estimative Method, M.E.R. According to this approach, once the level of degradation of individual functional elements that compose a building is determined, we can then determine the overall degradation index. This is given by a single degradation level of functional elements multiplied by the weights attributed to the influence of the interventions provided on the cost of total recovery. Therefore by Multiplying this index with the economic index (which is the function of price evolution for the impact of individual production factors on the local market), the total recovery cost is achieved. (Vicari J., Merminod P., 1981).

Another present method in literature is the Early Determination of costs, DAC, certainly more akin to situations proceeding regarding a large number of buildings, such as the Common building of historic centers, which, although belonging to the same urban area, have different characteristics and degradation levels. After defining the prevailing building typology in the territory of study and after having identified the related sample buildings for each type, a metric calculation estimative for interventions to be incurred to recover is drawn up. For each planned intervention, related to each functional element, a weight percentage on the total intervention cost is attributed, which defines for each sample building, the cost per square meter. To get the intervention, total cost must be multiplied with the parametric cost attributed to each sample building (of each type) for the sum of the surfaces of buildings to be included in the restoration project. This method is fairly fast and requires careful preliminary discernment to be able to identify the sample buildings. (Mollica E., 1995) (Musolino M., 1994).

Still, De Mare and Morano, for the recovery of the Sassi of Matera, have developed two models, basically constituted and joined by two phases, which are inspired by previous methods: … degradation cataloging for the identification of a buildings' conservation status and the estimation function of the cost of recovery. The first model, statistical empirical, is among mixed procedures: through the sum of the average unit cost of each functional element (for each type of identified degradation) multiplied by the habitable area of the building examined, the recovery cost is determined. Essentially, the level of degradation is defined from each functional element of the building according to the general classification made in the preliminary phase, the average unit cost is found (obtained by grouping parametric cost recovery of the functional elements of sample building in four classes of degradation, defining for each class the average cost of parametric costs), from then multiply by the habitable area of the property, in order to obtain the recovery cost relating to individual functional elements to be examined. By adding the single costs of a functional element, the total recovery cost of building is achieved (1):

$$C = a1\ X + a2\ X + \ldots + an\ X = (a1 + a1 + an)\ X \quad (1)$$

when

C, total recovery cost

a1, a2, an, average unit cost of recovery of single functional units

X, habitable area.

The second model, based on multiple regression analysis, estimates the recovery costs in function of the explicative variables identified in the level of degradation of the elements and the habitable area of the property, ranking among the synthetic pluriparametric estimation methods, providing the total amount of recovery cost directly. Both methods, although very reliable, are difficult to apply when there is a need to find the parametric costs of individual interventions related to the building's functional elements. (De Mare G., Morano P., 1997)

Finally, it is useful to cite a synthetic estimation procedure of the cost value created by the BEST Department of Politecnico di Milano. This procedure requires an extremely limited information framework and is designed according of updates to DPR 207/2010 Regulation implementing the Code of Contracts on the possibility of putting in competitive tenders basis for feasibility studies and preliminary projects (Utica G., 2011). The proposed estimation procedure consists in three phases:

a) identification of a classification plan, which has the aim to identify significant descriptors for project development divided into possible thematic areas.

b) measuring of the descriptors, ie the quantification of the classes of technical elements on the basis of planivolumetric hypothesized, being estimated (and not determinated) the quantities for each of the descriptors on the basis of the contents of only planivolumetric. To estimate the quantities to be allocated to each class of technical elements will be carried considerations put forward by the specific character of the building system, in most cases, values can be derived from literature, such usual amount of material or manufacture to m^3or m^2 of construction.

c) estimate of the unit price to be assigned to each descriptor, which results in the stratigraphy of each class of technical elements costs. In this phase will be identified which prices are necessary for the realization of the project, on basis of the quality level required: to each descriptor corresponds a price entry list prices for construction works that has been taken for the estimation.

In the case of the built requalification projects, the method includes the development of a survey that focuses the state of fact, in planiolumetric terms and on basis of the adopted classification plan, in order to have an estimate of the existing characters to compare with the result prefigured for the intervention.

More generally in the literature, the approach to the recovery of the historical center changes and evolves depending on the cultural context and situations in which it is formulated: specifically refers to the basic contributions from Forte 1974, Fusco Girard 1979, Miccoli 1996 and Mollica 1995, without which it would be difficult today to come to other formulations.

2.1 The experience in Abruzzo post-earthquake 2009

Very useful for our purposes is the experience made during the post-earthquake reconstruction in Abruzzo in 2009. On that occasion, it was necessary to identify - in a short time and with a substantial deficit of information - the approximate estimate of the costs related to the recovery of damaged buildings by the earthquake, aimed at

forecasting the financial needs for the implementation of the Plans of Reconstruction of several historical center (Carbonara S., 2013). The definition of these costs was based on the usability judgment of the buildings, to which a parametric cost was attributed (resulting from orders made for the occasion by the President of the Council of Ministers). The usability judgment, in turn, can be deduced from AeDES form - Agibilità e Danno nell'Emergenza Sismica - used by engineers for surveying in the field of housing, in the aftermath of the earthquake. Section 8 of this board are six distinct categories of ordinary buildings in relation to the damage occurs and the subsequent usability judgment, divided in:

- A. building fit for use: The building can be used in all its parts without endangering the lives of residents, even without making any provision of emergency services.
- B. temporarily uninhabitable building (all or part) not fit for use with measures of emergency.
- C. partially unusable building.
- D. building temporarily unusable for review with deepening
- E / F. Building unfit for use.

Three main phases of this operation can be identified:

- Identification of the surface of each housing unit;
- Attribution to each surface of the usability judgment;
- Application of parametric costs to the surfaces in the outcome of viability, in order to quantify the extent of the amounts necessary for the recovery of the buildings, to be investigated in subsequent project phases, through the drafting of bills of quantities.

In fact, the synthetic estimation, as repeatedly stated by the author, does not seek to identify the actual cost value on the real expenditure, but the maximum eligible expenditure for such recovery (Carbonara S., 2014). The costs identified for the main housing are summarized in Tab. 1:

Table 1. Cost summary for main residences

Building's category	contribution allocated	Reference legislation
Usability outcome A	Max € 10.000,00 for unit + € 2.500,00 for common parts	OPCM 3778/2009
Usability outcome B/C	450,00 €/mq+150,00/195,00 €/mq for strengthening of structural elements	OPCM 3779/2009
Usability outcome E	€/mq 1.276,00. Reference unit cost to be considered as convenience boundary between 'intervention of recovery and building replacement', represented by that for social house in the Abruzzo Region.	OPCM 3790/2009 Del. Giunta Reg. n° 615/2010

3. Framework Research

Firstly, it is necessary to place the research activity in a bigger outline,that proposes to build a cultural plan of Metropolitan city of Reggio Calabria, to whose strategic base there is the enhancement of inner areas and the tangible and intangible cultural heritage that characterizes them. The main theme of the proposal is the enhancement of elements related to Mediterranean Diet's original meaning, understood as a lifestyle. In this sense, the Diet, represent the cultural landscape designed by man in these territories defining a precise natural and cultural mosaic: in this outline a fundamental role is played by many historic towns, caretakers of knowledge and identity values of great importance to realization a development that is truly sustainable for these areas, however classified as disadvantaged. (Calabrò F., Della Spina L., Tramontana C., 2015) Hence the need for new ideas for the determination of the recovery costs.

3.1 The method De.S.C. - Determination of Synthetic costs

Based on the experiments conducted so far and the background provided by the bibliography in the previous paragraph, a new method has been formulated through this experimentation - De.S.C.- designed for synthetic determination of the recovery costs for widespread architectural heritage of unused historic towns, in conditions of considerable information deficit. This approach arises from the need to do evaluations in situation where is not possible to have more information, in programming phase, to understand the possible feasibility of a hypothetical intervention of recovery on historical buildings. Also it arises for the determination of a significant cost value even

if not exactly equivalent to that resulting from estimates of subsequent project phases. This value is sufficient to orient and make choices in the programming phase, aimed at renovation of the existing heritage, or in situations where heritage to be recovered is not easily accessible. Feasible hypothesis could be that the recovery of these unused buildings is, for example, feasible by the provision of public funds, subject to the use of such properties for economic goals that have positive impact on the area - in particular hotel services or tourist services - creating a system of incentives focused on public-private partnership logic. (Calabrò F., Della Spina L. 2014) (Della Spina L. et al. 2015) (Scrivo R., Viglianisi A. 2014) The estimate for recovery costs should be trusted, even more if intervention is financed by public resources: the programmatic phase it will be used parametric estimates which will be properly detailed in the later stages of design. The phases which characterize the proposed procedure, it should be recalled, in the testing phase, can be summarized as follows:

- Phase 1, sample building individuation, which emerged from a general analysis of historical towns related to the experimentation, represents the buildings' typical typology of the town in exam: in most cases it is between two buildings (inter-closed), with 2 levels, roof with tiles, interstorey wooden floor and essential finishes, with dimensional characteristics such as having approximately 90 square meters of habitable area.
- Phase 2, defining of the possible cases of verifiable conservation status, from which it is possible to determine 3 classes of buildings according to the level of degradation and the interventions necessary to make them functional (see Tab. 2), according to the hypothesis of reuse in the preliminary phase finalized at the creation of hospitality and tourism services activities; the identified classes, in research, are:
  Class A: applies to a building in good conservation status, that outside has vertical and horizontal structures which are still efficient and the external finishes in general are still intact: plasters in good condition and fittings to be maintained. It is assumed that inside the remaking of the toilets, floor maintenance, rehabilitating paintwork and window replacement, together with the adjustment of the electrical system and the realization of that conditioning is necessary.
  Class B: applies to a building in mediocre conservation status that outside has its vertical structures still intact, but needs maintenance to the roofing, facade and replacement windows. It is assumed inside the remaking of the toilets with its masonry, floors, part of plasters, paintings, frames and electrical, water and air conditioning system is necessary.
  Class C: applies to a building in bad conservation status, that outside presents problems to the support structure which would require a consolidation of the masonry work as well as the replacement of the cover. The plaster facade is in need of renovation and replacement windows. It is assumed that inside the remaking of intermediate floors, bathrooms, floors, crawl spaces and screeds, plaster, painting, windows and the electrical, water and air conditioning systems is necessary.

Table 2. scheme classes identification based on the conservation status that could occur and necessary work that needs to be performed

Interventions	Class A	Class B	Class C
Demolition	●	●	●
Vertical structures	-	-	●
Roof	-	○	●
Facade – outside plasters	-	○	●
External window frames	○	●	●
Iron works	-	●	●
Floor interstorey	-	○	●
Sanitation	●	●	●
Works of foundation	-	-	●
Floor	○	●	●
Wall	●	●	●
Inside plasters	-	○	●
Paintings	●	●	●
Internal windows frame	●	●	●
Water system	-	●	●
Electric system	○	●	●
Conditioning system	●	●	●

- No intervention; ○ Maintenance / adaptation;

● Reconstruction / construction

- Phase 3, identification of parametric recovery cost Pc (EUR / m²) for each previously defined class. Once decomposed the three sample buildings representative of each of the three categories identified in the principal functional elements and after having identified its interventions through a metric estimative calculation of the necessary works and makes it functional for reuse hypothesized was calculated the recovery cost for each class (see Table 3), with the following result:

Table 3. Buildings the CME was drawn up from with the total recovery cost for each identified class inferred

		
Class A ***Total recovery cost € 40.500,00***	***Class B*** ***Total recovery cost € 72.000,00***	***Class C*** ***Total recovery cost € 108.000,00***

How the determination of Pc parametric recovery cost for each identified class, will be obtained (see Table 4):

Table 4. Parametric cost Pc for each of the identified classes.

Class A	***U. C. €/m²***	***Class B***	***U. C. €/m²***	***Class C***	***U. C. €/m²***
building in good conservation status	450,00	building in mediocre conservation status	800,00	building in bad conservation status	1.200,00

- Phase 4, the data collection related to the common heritage to be included in the intervention and its calculation of the costs of recovery. For this step will use of a properly set-up form, that locate and registers dimensional quantification, necessary data to frame the buildings to be included in the recovery plan and for the calculation of the total cost of recovery (TRC) detected building (TRC-A, TRC-B, TRC-C). This cost can be determined expeditiously during processing of form, once ranked the building object of the relief according to one of three classes identified based on the conservation status, multiplying the surface habitable by parametric cost corresponding previously determined, as in Table 5:

Table 5. Extract from calculation form for total recovery cost TRC

Class A	***U.A. m²***	***U. C. €/m²***	***TRC-A, Total recovery cost***
building in good conservation status	……	450,00	0,00 €
Class B	***U.A. m²***	***U. C. €/m²***	***TRC-B, Total recovery cost***
building in mediocre conservation status	…….	800,00	0,00 €
Class C	***U.A. m²***	***U. C. €/m²***	***TRC-C, Total recovery cost***
building in bad conservation status	……	1.200,00	0,00 €

Phase 5, determining the total cost TCI of a hypothetical intervention of recovery of reusable deemed buildings, for example, for receptive purposes in a situation of tourism in the historic towns, within the perspective of a larger project that includes a plan for the old Town in question based on their own local resources. This cost TIC is determined by the sum of the individual recovery costs calculated for each

building detected by means of the form (see Table 6), according to the following formula (2):

TIC= (TRC -A1+ TRC -A2+ … TRC -An) + (TRC -B1+ TRC -B2+ …. TRC -Bn) + (TRC -C1+ TRC -C2+ …. TRC -Cn) (2)

When

TIC, total intervention cost

TRC -An, the total cost of building Class A recovery

TRC -Bn, total cost recovery for Class B buildings

TRC -Cn, the total cost of building a Class C Recovery

Table 6. Synthesis of TIC Tab, be filled in at the experimentation end.

	Buildings N.	***TRC, total recovery cost for each class***
Class A	……	0,00 €
Class B	……	0,00 €
Class C	……	0,00 €
TIC Total Intervention Cost		**0,00 €**

4. Comparing experiences

Taking into account the parametric unit costs derived from bibliography on the various approaches outlined for recovery of historical centres, although highlighted the different purpose - for recovery of abandoned and centres for post-earthquake recovery - and the different categories classification of buildings - always depending on the state of conservation / outcome condition - it can be said that is possible to find a certain congruence between the estimated cost parameters, as in Tab. 7. Notwithstanding the differences, this comparison, in a sense could validate the De.S.C. instrument, which to date is still being tested.

Table 7. Parametric costs compared to comparable buildings classes.

Sassi of Matera experience 1997*		***L'Aquila experience, 2010***		***De.S.C. experience, 2016******	
building class	*parametric cost*	*building class*	*parametric cost*	*building class*	*parametric cost*
Low degradation **	160,10 €/mq	Usability outcome A	450, 00 €/mq	Class A	450,00 €/mq
Medium degradation	751,96 €/mq	Usability outcome C	645,00 €/mq	Class B	800.00 €/mq
High Degradation	1446,00 €/mq	Usability outcome E	1276,00 €/mq	Class C	1200 €/mq

* Unit Costs converted to Euros

** this parametric cost does not provide for the realization of the toilets, the electrical and air conditioning (already present and functional)

*** Being tested

The comparison may be given for certain forced verses, whereas the multiplicity of variables in each case must take into account: such as the different construction techniques, the different level of the decorative that minor building lacks and especially the destination end use attributable to buildings. In this sense a question is residential construction, another is the intended use for receptive purposes, which requires, for example, the construction of more toilets.

5. Conclusion

More generally, about the validity of the speed estimation methods of the costs described above without pretending to be an exhaustive treatment, it is necessary to say that each method is characterized by a different purpose, that has like goal the recovery of existing built according to different approaches. One of two approaches is related to the need to program the recovery and reutilization of entire abandoned centers falling in territories of particular disadvantage and lagging; the other approach must rapidly respond to housing needs as a result of damage of an earthquake through the quantification of the actual costs to be incurred for the recovery.

Specifically, as regards the De.S.C. method the following advantages are found:

- The possibility to significantly reduce the error of estimates made in the planning phase for restoration work of historical unused heritage;
- The rapidity with which can be made parametric estimates of the recovery cost of an indefinite number of buildings;
- The approach replicability in similar contexts.

The disadvantages at the moment are mainly associated with the possible aleatory of obtained estimates, if compared with those obtainable through the application of other methods that, however, need a core of information does not always easy retrieval. In each case, as already anticipated, the experimentation was just initiated, therefore no data are available to confirm or not the validity of the proposed method.

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